Aaditya Datar

BS-MS Dual Degree · Physics

Indian Institute of Science Education and Research, Pune

(+91) 9860036838 | aadityadatar.physics@gmail.com | aadityadatarphysic.wixsite.com/aadityadatar | aadityadatar13 | Aaditya Datar

Education

Indian Institute of Science Education and Research (IISER), Pune

Pune, India

BS - MS Dual Degree, Physics Major

Aug. 2020 - May 2025

- CGPA: 9.0/10
  Major CGPA (Physics): 9.2/10
- Master's Thesis: Virasoro Blocks and the Black Hole Information Paradox
  Supervisor: Dr. Chethan Krishnan, CHEP, Indian Institute of Science
  Grade: 88.35/100
- DST INSPIRE Scholarship fellow: Awarded by the Department of Science and Technology to promising students pursuing higher education in the natural sciences in India

Publications

Low energy elastic and inelastic scattering of positrons from formic acid

Canberra, Australia

Journal of Physics B: Atomic, Molecular and Optical Physics, Volume 57, Number 17

Summer 2023

- This paper presents a detailed study of low energy positron scattering from formic acid, examining elastic scattering, electronic excitation and ionisation processes. Through detailed comparisons with previous experimental and theoretical data, it is clear that the picture for positron scattering from this target remains incomplete, with significant disagreement between experiment and theory in the comparisons of differential cross section data. Calculations of elastic electron scattering are unexpectedly in better agreement with the positron scattering experiments, and give some hints as to potential areas for improvement in the modelling of scattering for targets which tend to be dominated by dipole interactions. For more details, you can refer to the open access paper: **Low energy elastic and inelastic scattering of positrons from formic acid**

Projects

Thesis: Virasoro Blocks and the Black Hole Information Paradox

Bengaluru, India

Master's Thesis Student (Supervisor: Dr. Chethan Krishnan, Centre for High Energy Physics, IISc)

May 2024 - Mar. 2025

- Under the mentorship of Dr. Chethan Krishnan, I worked on a master's thesis project wherein I studied the relation between Virasoro conformal blocks and the black hole information loss problem in AdS_3/CFT_2.
- Among other things, I found a novel bulk prescription and interpretation that makes the role of the Euclidean horizon clear, as well as connects it with another manifestation of the paradox in 2D CFT, namely, periodic singularities. The results have been drafted in the following preprint **Virasoro Blocks and Trouble at the Euclidean Horizon**.

Benchmark Positron Scattering Experiments

Canberra, Australia

Research Assistant, Positron Research Group, Australian National University

Summer 2023

- Under the mentorship of Dr. James Sullivan and Mr. David Stevens, I worked on a project that sought to measure and analyze the scattering of positrons from the molecular target formic acid using a state-of-the-art beamline at the Australian Positron Beamline Facility.
- The measurement of differential cross sections (DCS) and grand total cross sections (GTCS) for electronic excitations and ionization were made for the first time for this molecular target, and the data will be used to test the latest quantum models of low energy scattering. The results from this experiment has been published in the paper "***Low energy elastic and inelastic scattering of positrons from formic acid***" in the ***Journal of Physics B: Atomic, Molecular and Optical Physics***. For more details, check the "Publications" tab above.

Entanglement of helicities in tree-level QED processes

Pune, India

Project Student (Supervisor: Dr. Arun Thalapillil)

Aug. 2023 - Nov. 2023

- I worked on a project that involved studying the entanglement of helicity degrees of freedom of electrons, and how they evolve when they undergo standard QED processes like Møller or Bhabha scattering at the tree-level.
- Entanglement measures for two-state bipartite systems were studied and results in "***Tree-level entanglement in Quantum Electrodynamics***" by Fedida et al. were reproduced using spinor helicity amplitudes. The idea was to modify this result for a three outgoing particle state for which we tried to come up with useful tripartite entanglement measures and use the helicity techniques to extend the idea of entanglement in scattering amplitudes for "2 - 3" processes. For more details, refer to the project report

Introduction to General Relativity and Black Holes

Pune, India

Project Student (Supervisor: Dr. Arijit Bhattacharyay)

Jan. 2023 - Apr. 2023

- I worked on a project that involved learning the basics of Einstein's Theory of General Relativity. The main aim of this project was to get acquainted with the essential ideas of how our current, and best framework of gravity relies on understanding spacetime in a geometric way.
- Standard texts in GR were used as a reference; since this was a reading project, the final report (click here to view the report) summarizes the basic ideas of general relativity, with emphasis given on describing the physics involved, as also the non-trivial derivations of the Schwarzschild metric, interior and exterior solutions of stars.

Introduction to Quantum Computation and Quantum Information

Pune, India

Project Student (Supervisor: Dr. T.S Mahesh) *Aug. 2022 - Nov. 2022*

- I worked on a project which aimed at introducing the foundational concepts in quantum information and quantum computation.
- The project was notionally divided in two parts: the first half was where I studied the basic concepts and terminology using standard pedagogical resources (for instance, the text by Nielsen and Chuang).
- In the second half of the project, I used IBM Quantum's Qiskit to calculate fundamental entanglement properties like correlation functions of electrons by using quantum circuits and manipulating qubits as a proxy to electron spin. (click here to view the report).

Introduction to Experimental High Energy Physics

Pune, India

Project Student (Supervisor: Dr. Sourabh Dube) *May 2022 - July 2022*

- I worked on a project that served as a qualitative and technical introduction to research in experimental high energy physics. Pedagogical sources were used to study the Standard Model of elementary particles and modern detector physics used at CMS and ATLAS in the LHC.
- I used data obtained at CMS for a particular search to analyze and interpret the underlying process. Using ROOT and applying standard EHEP analysis techniques, I found that it was the Drell-Yan process. The project report (click here to view the report) documents the last (analysis) part of the project very briefly.

Honors & Awards

International

2023 — **Australian National University Future Research Talent Scholar 2023,** The Future Research Talent (FRT) awards are jointly offered by ANU College of Science, ANU College of Health and Medicine and ANU College of Engineering and Computer Science to students from India; the award includes a scholarship and an opportunity to travel to ANU to pursue collaborative research, for a period of 10-12 weeks, in a range of Science, Health and Medicine disciplines. *Canberra, Australia*

Domestic

2020-2025 — **DST INSPIRE Fellowship,** Funded by the Department of Science and Technology (DST) of the Government of India; this scholarship is awarded to the top 1% meritorious students in India to undertake education in the natural sciences for the duration of their degree courses, based on an academic (CGPA) criterion. *India*

2022 — **Summer Research Fellowship Program 2022,** Selected for a summer research fellowship through a program organized by the prestigious Indian Academy of Sciences. *Bengaluru, India*

2020 — **AIR 4732,** Achieved an All India Rank (AIR) 4732 out of 160,000 aspirants selected from JEE Mains in the Joint Entrance Examination (Advanced) *India*

2020 — **AIR 3936,** Achieved a 99.66 percentile cumulative score (AIR 3936) out of 1.1 million aspirants along with a 99.94 percentile score in Physics in the Joint Entrance Examination (Mains) 2020. *India*

Skills

Programming C++, Python
Software Mathematica, MATLAB, LaTeX, Microsoft tools
Languages English, Marathi, Hindi, German

Extracurricular Activity

IISER Pune Men's Basketball Team

Pune, India

Member *Dec. 2022*

- Played for the IISER Pune Men's Basketball team in the Inter-IISER Sports Meet (IISM) 2022, Bhopal.

IISER Pune Quiz Club (IPQC)

Pune, India

Club Coordinator *Sept. 2021 - Aug. 2022*

- Handled the organization and management of various quizzing events within and outside IISER Pune in the role of a club coordinator.

Mimamsa

Pune, India

Physics Question Making Team member *Sep. 2021 - Mar. 2024*

- Designed questions based on high school level physics concepts aimed at testing logical and critical thinking skills of the contestants of Mimamsa, India's premier science quiz for undergraduates.

Science Nurture Program (SNP)

Pune, India

Volunteer *Sep. 2021*

- Conducted talks in various topics in physics and mathematics to popularize science education among high school students.